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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/027,462	12/21/2001	Leonid Yaroslavsky	10010525-1	1553

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AGILENT TECHNOLOGIES, INC.
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EXAMINER	
SETH, MANAV	

ART UNIT	PAPER NUMBER
2624	

DATE MAILED: 03/31/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/027,462	YAROSLAVSKY ET AL.	
	Examiner	Art Unit	
	Manav Seth	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 January 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-35* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *5-20 and 31-33* is/are allowed.

6)☒ Claim(s) *1,2,21,23,25-27,30,34 and 35* is/are rejected.

7)☒ Claim(s) *3,4,22,24,28 and 29* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. The amendment received on January 20, 2006 has been entered in full.

2. Applicant's arguments to the claims have been considered but are not persuasive.

Response to Arguments

3. Applicant's arguments with respect to claims 1, 2, 21, 23, 25-27, 30, 34 and 35 regarding the prior art rejections under Zwirn, Onoguchi and Rooks on pages 15-30 of the amendment filed on January 20, 2006, have been fully considered but are not persuasive.

Regarding Claim 1, claim 1 recites a method of automatically focusing an imaging system on an object comprising: using

either (1) **a comparison between an image of a typical object and the image of the object created by the imaging system,**

or (2) **an edge density in an image of the object and the comparison,** to determine an optimum focus position.

Examiner chose the 2nd alternative **"edge density in an image of the object and the comparison"** to determine an optimum focus position to reject the claim 1. The second alternative is completely silent of what type of specific comparison is to be made. Applicant argues in substance that Zwirn does not teach "a comparison between an image of a typical object and the image of the object created by the imaging system". However, the second alternative of the claim 1 does not

recite such a specific comparison as it just says "comparison". If the applicant wishes the office to consider the comparison recited in the second alternative to be a comparison between an image of a typical object and the image of the object created by the imaging system, the applicant should add such a limitation in the claim in the first place.

Applicant further argues in substance in 3rd and 4th paragraph of page 17 of 30 of the amendment filed that "Zwirn clearly do not disclose, explicitly or implicitly, comparing images of an object or using such image comparison for focusing. Moreover, the only comparison disclosed or suggested by Zwirn is the comparing of the control signals". Examiner respectfully disagrees with applicant on this limitation. "A person using a camera or microscope can determine the optimal or sharp focus by looking at the focused image and then based on his/her capability of viewing image appropriate sharpness or focusing can be selected" or "a person by just looking at two images taken at different focus settings can determine or select the best focused image". But the same problem of obtaining a focused image automatically using an image processing system or a computer system is totally different. A computer system cannot determine the optimal or sharp focus by just looking at the focused images as done by a human operator, but it has to perform some calculations on the image data by considering image characteristics such as measuring high frequency components in an image which is well-known to determine the best focus and Zwirn clearly teaches the same by comparing video image signals (control signals) which are related to image characteristics such as edge density to determine an optimum focused image (col. 4, lines 24-40). **Zwirn clearly discloses "The video signal is an electronic image of the scene under focus" (col. 3, lines 40-41).** Zwirn discloses "the present invention relates to the field of automatic focusing systems and more particularly to the field of automatic focusing systems driven by **scene information**" (col. 1, lines 5-10), particularly information relating to the high frequency spectral (edge) density of the scene (col.

1, lines 54-58), where it is apparent that a scene could be an object focused by an imaging system. Zwirn further discloses determining an optimum focus position by adjusting the focus position towards the focus position where the high frequency content increases thereby increasing the sharpness of the focus (optimum focus) (col. 1, lines 62-65; col. 2, lines 1-10, lines 41-45, col. 3, lines 50-60; col. 4, lines 35-39). Therefore, the rejection on claim 1 still stands. **Similarly, claim 21** recites broadly (claim does not teach specific image comparisons) using either (1) an image comparison-based determination or (2) an edge density-based determination and the image-comparison based determination, and Zwirn as discussed before teaches both alternatives as the claim recites just image comparison and does not recite any specific image comparison. Claim 21 still stands rejected. **Claim 26 similarly** as claim 1 recites using any of two alternatives and the second alternative being "both of an edge density determination and the image comparison to determine an optimum focus position for imaging the object". Claim 26 is still rejected for the same reasons as applied to claim 1. Similarly claims 34 and 35 recite using one or both of edge density-based and image based comparison which directs to using either (1) edge-density based or (2) image comparison based or (3) edge-density and image comparison based. Claims 34 and 35 still stand rejected for the same reasons as per the claim 1, as Zwirn does teach edge-density based. All other arguments regarding other claims dependent on the claims discussed before are not persuasive and therefore the claims stand rejected.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1-2 are rejected under 35 U.S.C. 102(b) as being anticipated by Zwirn et al., U.S. Patent No. 4,789,898.

Claim 1 recites a method of automatically focusing an imaging system on an object comprising: using either (a) **a comparison between an image of a typical object and the image of the object created by the imaging system,** or (b) **an edge density in an image of the object and the comparison,** to determine an optimum focus position. As the claim 1 recites using one alternative to determine an optimum focus position, examiner chose only **edge density in an image of the object and the comparison** to determine an optimum focus position to reject the claim 1.

In the previous office action mailed on May 13, 2005, examiner considering the broad interpretation of the claim 1 chose "only edge density to determine an optimum focus position", however examiner did not disclose (or agree) that this reference by Zwirn does not teach "determining an optimum focus position using an edge density in an image of the object and the comparison". Examiner did use the reference Zwirn to reject claim 3, which involves comparison of images also, in addition to edge density calculation.

Zwirn discloses "the present invention relates to the field of automatic focusing systems and more particularly to the field of automatic focusing systems driven by **scene information**" (col. 1, lines 5-10), particularly information relating to the high frequency spectral (edge) density of the scene (col. 1, lines 54-58), where it is apparent that a **scene could be an object focused by an imaging system.** Zwirn further discloses determining an optimum focus position by adjusting the focus position towards the focus position where the high frequency content increases thereby

increasing the sharpness of the focus (optimum focus) (col. 1, lines 62-65; col. 2, lines 1-10, lines 41-45, col. 3, lines 50-60; col. 4, lines 35-39).

Zwirn further discloses "As the video information gathering device is brought into focus the high frequency content of the video signal will increase. By passing the video signal through a band pass filter and then processing it in a conditional integrator, a control signal is generated whose amplitude contains information relating to the degree of focus. The control signal is stored and later compared to a control signal derived from a subsequent scanning. Once a significant change in control signal levels is detected a drive signal is sent to the focusing device. If after being driven the subsequent scene has less high frequency (edge density) content, the a drive signal in the opposite polarity or direction is sent to the focusing device. In this manner the scene is toggled into focus only when the scene is initially defocused" (col. 1, lines 62-68 through col. 2, lines 1-10). It is clear from the above disclosure by Zwirn that a control signal which is a measure of edge density (high frequency components) of each scan (or image) of the scene (or object) at each different focus is computed and then according to the focus or scan position that has the greatest edge density (high frequency components) the optimum focus position is determined and thus a set of images (scans) of the scene are evaluated using edge density. The first control signal representing first focus position stored in the memory is compared to the second (subsequent) control signal representing second (subsequent) focus position, to determine the direction of the focusing to obtain optimum (third) focus position.

Since Zwirn does cover the method (b) which recites both an "edge density and image comparison", therefore method using "image comparison" or method "edge density", to compute a optimum focused image, automatically are covered under the same rejection.

Claim 2 recites "the method of claim 1, wherein using an edge density in an image of the object comprises: computing the edge density of each image of a set of images of the object; and using a focus position corresponding to an image of the set having a greatest edge density as the optimum focus position". Zwirn further discloses "As the video information gathering device is brought into focus the high frequency content of the video signal will increase. By passing the video signal through a band pass filter and then processing it in a conditional integrator, a control signal is generated whose amplitude contains information relating to the degree of focus. The control signal is stored and later compared to a control signal derived from a subsequent scanning. Once a significant change in control signal levels is detected a drive signal is sent to the focusing device. If after being driven the subsequent scene has less high frequency (edge density) content, then a drive signal in the opposite polarity or direction is sent to the focusing device. In this manner the scene is toggled into focus only when the scene is initially defocused" (col. 1, lines 62-68 through col. 2, lines 1-10). It is clear from the above disclosure by Zwirn that a control signal which is a measure of edge density (high frequency components) of each scan (or image) of the scene (or object) at each different focus is computed and then according to the focus or scan position that has the greatest edge density (high frequency components) the optimum focus position is determined and thus a set of images (scans) of the scene are evaluated using edge density.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the

subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 21, 23, 26-27 and 34-35 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zwirn et al., U.S. Patent No. 4,789,898, further in view of Onoguchi et al., U.S. Patent No. 6,067,164.

Claim 21 recites "An imaging system having automatic focusing comprising: an imaging subsystem that images an object; a memory; a computer program stored in the memory; and a controller that executes the computer program and controls the imaging subsystem, wherein the computer program comprises instructions that, when executed by the controller, implement using an image of the object created by the imaging system to determine an optimum focus position, the determination being either **image comparison-based** or **edge density-based and image-comparison-based**". Zwirn discloses video camera (col. 3, lines 42-45) which captures the object or scene image and sends it to the circuit in figure 1, where figure 1 shows the controller which controls the auto-focusing performed by video camera and Zwirn as discussed in the rejection of claim 2, also uses memory to store the degree of focus (edge density) value which is calculated to determine the optimum focus position. Zwirn does teach automatic focusing using the circuit in figure 1 but Zwirn does not teach the control of automatic focusing using a software stored on a memory but it is very well known in the art that any image processing function controlled using only a hardware, can also be controlled using software and this is further supported by Onoguchi.

Onoguchi performs auto-focusing on electron microscope for semiconductor inspection (col. 3, lines 40-52; col. 20, lines 13-21) and teaches high frequency component determination to find the sharp focus position (col. 24, lines 58-68) and further teaches that the auto-focusing can be

controlled using a computer readable program embedded on a computer readable medium (memory) (col. 4, lines 34-41). Therefore, it would have been obvious for one of ordinary skill in the art at the time of invention was made to control the auto-focusing using a computer program as taught by Onoguchi in the invention of Zwirn because both references belong to the same field of automatic focusing of an object and Onoguchi an automatic image auto-focusing using software so that a work load on the operator can be reduced while the throughput of the process can be improved considerably (see Onoguchi: col. 3, lines 50-52). Onoguchi further teaches "the present invention may be conveniently implemented using a conventional general purpose digital computer programmed according to the teachings of the present specification, as will be apparent to those skilled in the computer art. Appropriate software coding can readily be prepared by skilled programmers based on the teachings of the present disclosure, as will be apparent to those skilled in the software art" (col. 28, lines 49-57). All other limitations recited in claim 21 have been similarly analyzed and rejected as per claims 1-3, 5, 7-8, and 10-12.

Claim 23 has been similarly analyzed and rejected as per claims 21 and 1-2.

Claim 26 has been similarly analyzed and rejected as per claims 21 and 1.

Claims 27 has been similarly analyzed and rejected as per claims 26, 23, 21, 1 and 2.

Claims 34-35 has been similarly analyzed and rejected as per claims 26, 23, 21, 27, 1 and 2

8. Claims 25 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zwirn et al., U.S. Patent No. 4,789,898, further in view of Onoguchi et al., U.S. Patent No. 6,067,164 and further in view of Rooks et al., IEEE, June 5, 1999, "Development of an inspection process for ball-grid-array technology using scanned-beam x-ray laminography".

Claim 25 recites "the image system of claim 21 being an x-ray laminography system". Zwirn and Onoguchi both does not disclose the image system being an x-ray system, but Onoguchi as discussed in the rejection of claim 21 discloses semiconductor inspection using automatic focusing of microscope and Zwirn as discussed in the rejection of claim 1 teaches "the present invention relates to the field of automatic focusing systems and more particularly to the field of automatic focusing systems driven by **scene information**" (col. 1, lines 5-10). Rooks teaches that in order to inspect the eutectic-solder fillets of BGA joints using an X-ray system, **the system must be able to focus on a particular horizontal cross-sectional plane** and, therefore, isolate the solder fillets from the solder balls and Rooks further teaches Scanned-beam x-ray laminography (SBXLAM) which is the only **automated** solder inspection system which is capable of focusing on a horizontal plane to examine features within the plane with great detail and contrast (page 851, right col., last para. through page 852, left col.). Therefore, it would have been obvious for one of ordinary skill in the art to use the automatic focusing as taught by combined invention of Zwirn and Onoguchi in the X-ray laminography system of Rooks because Zwirn teaches "the present invention relates to the field of automatic focusing systems and more particularly to the field of automatic focusing systems driven by **scene information**" which is also applicable to Rooks, as Rooks wants to isolate the **solder fillets from the solder balls** (scene information) by using system that is able to focus on a particular horizontal cross-sectional plane as discussed before, which is scene driven focusing and

Onoguchi discloses semiconductor inspection which is also applicable to Rooks. Further Rooks teaches automated system, from which it is clear the focus is automatically performed by system and further support is provided by Rooks on page 860, right column, first paragraph.

Claim 30 has been similarly analyzed and rejected as per claims 26, 25, 1 and 2.

Allowable Subject Matter

Reasons of Allowance:

9. Claims 5-20 and 31-33 are allowed.

The following is an examiner's statement of reasons of allowance:

The instant invention relates to a method of determining a change in focus position of an imaging system. The reasons of allowance should be evident from applicant's arguments recited in the last paragraph of page 15 of 30 through first paragraph of page 16 of 30. Applicant's arguments in view of the applicant's specification recite the arguments with respect to "the typical object" and "an image or set of images being imaged by the imaging system" where the "image of the typical object" and "the image of object created by the imaging system" **are images of different objects.** The prior art of record (Zwirn et al., U.S. Patent No. 4,789,898) does teach obtaining the optimal focused image by the difference between the images at different focuses of the same scene (or object) but does not teach obtaining the optimal focused image by the difference between the image of a typical object and the image of the object obtained by the imaging system where the images are from different objects, as recited in the claims 5, 10 and 31. The invention method further

comprises comparing the image of the second object to the images in the set of images of the first object to find a closest matching image, the closest matching image from the set having an associated third focus position; and determining a change in the second focus position to provide an optimum focus position for imaging the second object with the imaging system where the object being representative of a class of objects. These features in combination with the other elements of the claim 15, are not disclosed or suggested by the prior art of record. Therefore, claims 5, 10, 15 and 31 are allowed and all other claims depending on claims 5, 10, 15 and 31 are allowed at least by dependency on claims 5, 10, 15 and 31.

10. Claim 4 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons of allowance:

The reason of allowance should be evident from applicant's arguments on pages 21 and 22 of 30 of the amendment filed.

11. Claims 3, 22, 24, 28 and 29 are objected to as being dependent upon a rejected base claim but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons of allowance:

The same reasons of allowance are applied to claims 3, 22, 24, 28 and 29 as applied to claims 5, 10, 15 and 31.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Manav Seth whose telephone number is (571) 272-7456. The examiner can normally be reached on Monday to Friday from 8:30 am to 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta, can be reached on (571) 272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Manav Seth
Art Unit 2625
March 27, 2006

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